



(12) **United States Patent**
Matsuyama

(10) **Patent No.:** **US 9,403,699 B2**
(45) **Date of Patent:** **Aug. 2, 2016**

(54) **ELECTROLYSIS WATER-MAKING APPARATUS**

(56) **References Cited**

(75) Inventor: **Koki Matsuyama**, Tokyo (JP)

(73) Assignee: **Morinaga Milk Industry Co., Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 194 days.

(21) Appl. No.: **13/517,177**

(22) PCT Filed: **Nov. 19, 2010**

(86) PCT No.: **PCT/JP2010/070678**

§ 371 (c)(1),
(2), (4) Date: **Jun. 19, 2012**

(87) PCT Pub. No.: **WO2011/077875**

PCT Pub. Date: **Jun. 30, 2011**

(65) **Prior Publication Data**

US 2012/0261255 A1 Oct. 18, 2012

(30) **Foreign Application Priority Data**

Dec. 25, 2009 (JP) 2009-296082

(51) **Int. Cl.**
C02F 1/461 (2006.01)

(52) **U.S. Cl.**
CPC **C02F 1/46104** (2013.01); **C02F 2201/002** (2013.01); **C02F 2201/004** (2013.01)

(58) **Field of Classification Search**
CPC C25B 9/06; C25B 9/18; C25B 9/20; C25B 9/203; C25B 9/206; C02F 1/46; C02F 1/46104

See application file for complete search history.

U.S. PATENT DOCUMENTS

1,506,307 A 8/1924 Kirkaldy
4,533,451 A * 8/1985 Kumazawa C02F 1/46104
204/228.3

(Continued)

FOREIGN PATENT DOCUMENTS

FR 2709430 A1 3/1995
GB 2186596 A 8/1987

(Continued)

OTHER PUBLICATIONS

International Search Report issued in International Application No. PCT/JP2010/070678, dated Feb. 22, 2011, 4 pages.

(Continued)

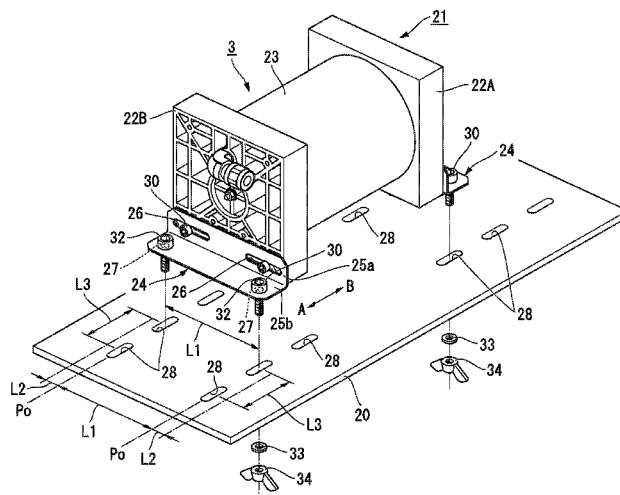
Primary Examiner — Ciel Thomas

(74) Attorney, Agent, or Firm — Wood, Herron & Evans, LLP

(57) **ABSTRACT**

The invention relates to an electrolysis water-making apparatus where an electrolytic cell in which a unit cell is provided in a casing, is fixed to an installation base by a fixture attached to the electrolytic cell, and, through a pipe group, electrolyte solution is supplied into the electrolytic cell, and electrolyzed products produced in the electrolytic cell are delivered. The electrolysis water-making apparatus is characterized in that: in the installation base, there are formed one or two or more through holes, depending on the size of the electrolytic cell, through which through hole the end part of the fixture can be inserted; an end part of the fixture is inserted through a through hole, which is selected from the one or two or more through holes depending on the size of the electrolytic cell; and an end part of the fixture which projects from the installation base is locked on the installation base. The electrolysis water-making apparatus can be easily produced in a short time, and can be provided at a low price.

11 Claims, 15 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

5,389,210	A	2/1995	Silveri	
5,538,606	A	7/1996	Hishida	
6,193,869	B1 *	2/2001	Towe et al.	204/632
7,326,325	B2 *	2/2008	Liang et al.	204/524
2002/0031697	A1 *	3/2002	Sugita	H01M 8/0271 429/434
2004/0045815	A1 *	3/2004	Tseng et al.	204/252
2007/0284251	A1 *	12/2007	Zuback et al.	204/518
2008/0073288	A1 *	3/2008	Fan et al.	210/748

FOREIGN PATENT DOCUMENTS

JP	04-36736	B	3/1992
JP	06226258	A	8/1994
JP	07-501487	A	2/1995
JP	08103771	A	4/1996
JP	11169856	A	6/1999
JP	2000-504619	A	4/2000
JP	2000355782	A	12/2000

JP	2001062455	A	3/2001
JP	2003190953	A	7/2003
JP	2005138001	A	6/2005
JP	2005161196	A	6/2005
JP	2006167699	A	6/2006
JP	2008-084727	A	4/2008
KR	20030017898	A *	3/2003 H02K 15/00
KR	100458604	B1	12/2004
KR	100599551	B1	7/2006

OTHER PUBLICATIONS

European Patent Office, Search Report issued in Application No. 10839111.1, mailed Sep. 5, 2013, 5 pp.

Japanese Patent Office, Office Action issued in Application No. 2011-547412, mailed Sep. 10, 2013, 3 pp.

Office Action issued in Taiwanese Patent Application No. 099142778; Jun. 10, 2013; 7 pages.

Korean Patent Office, Notice of Allowance issued in Application No. 10-2012-7014290, mailed Mar. 28, 2014, 3 pp.

* cited by examiner

FIG. 1

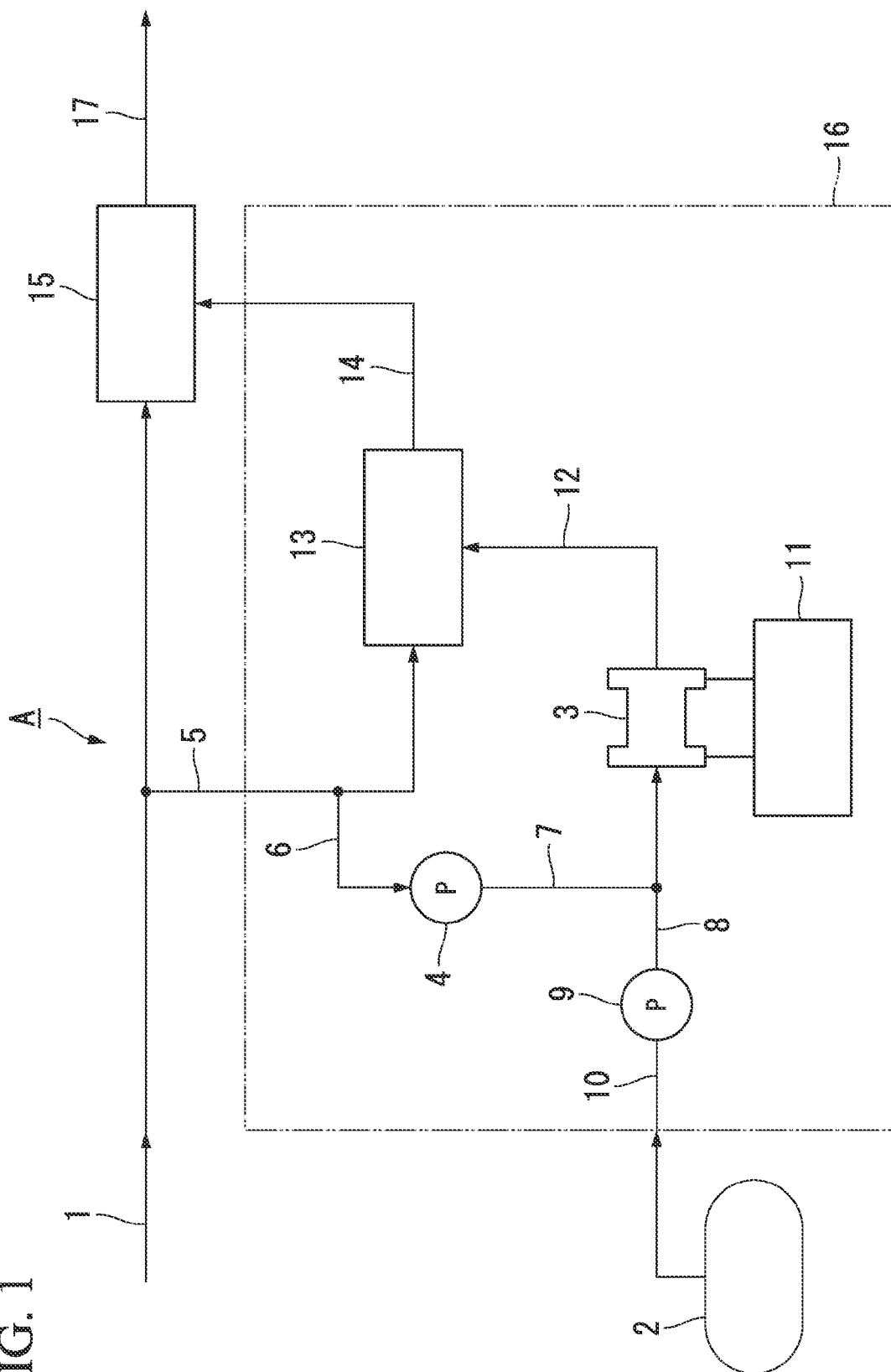


FIG. 2

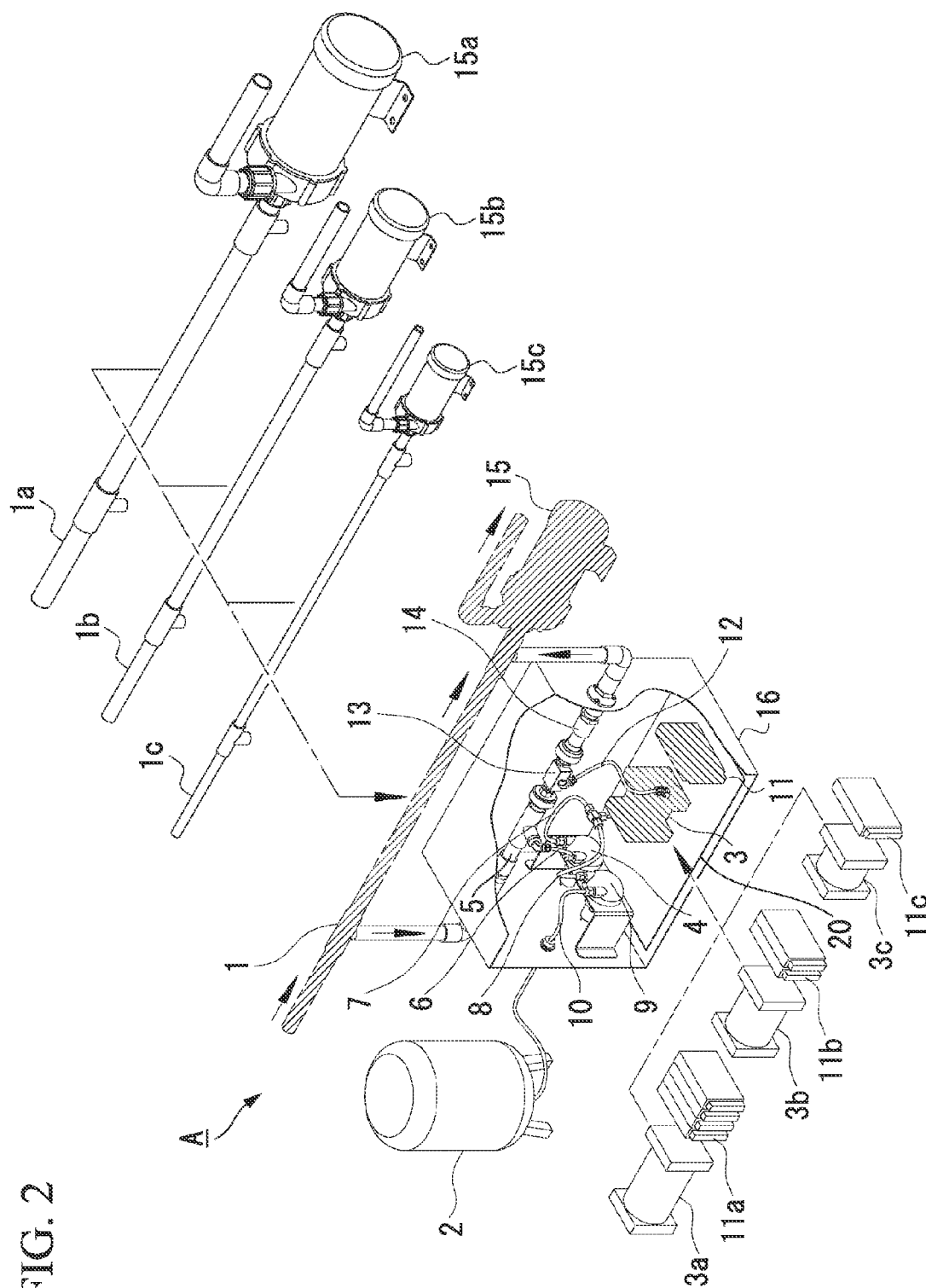


FIG. 3

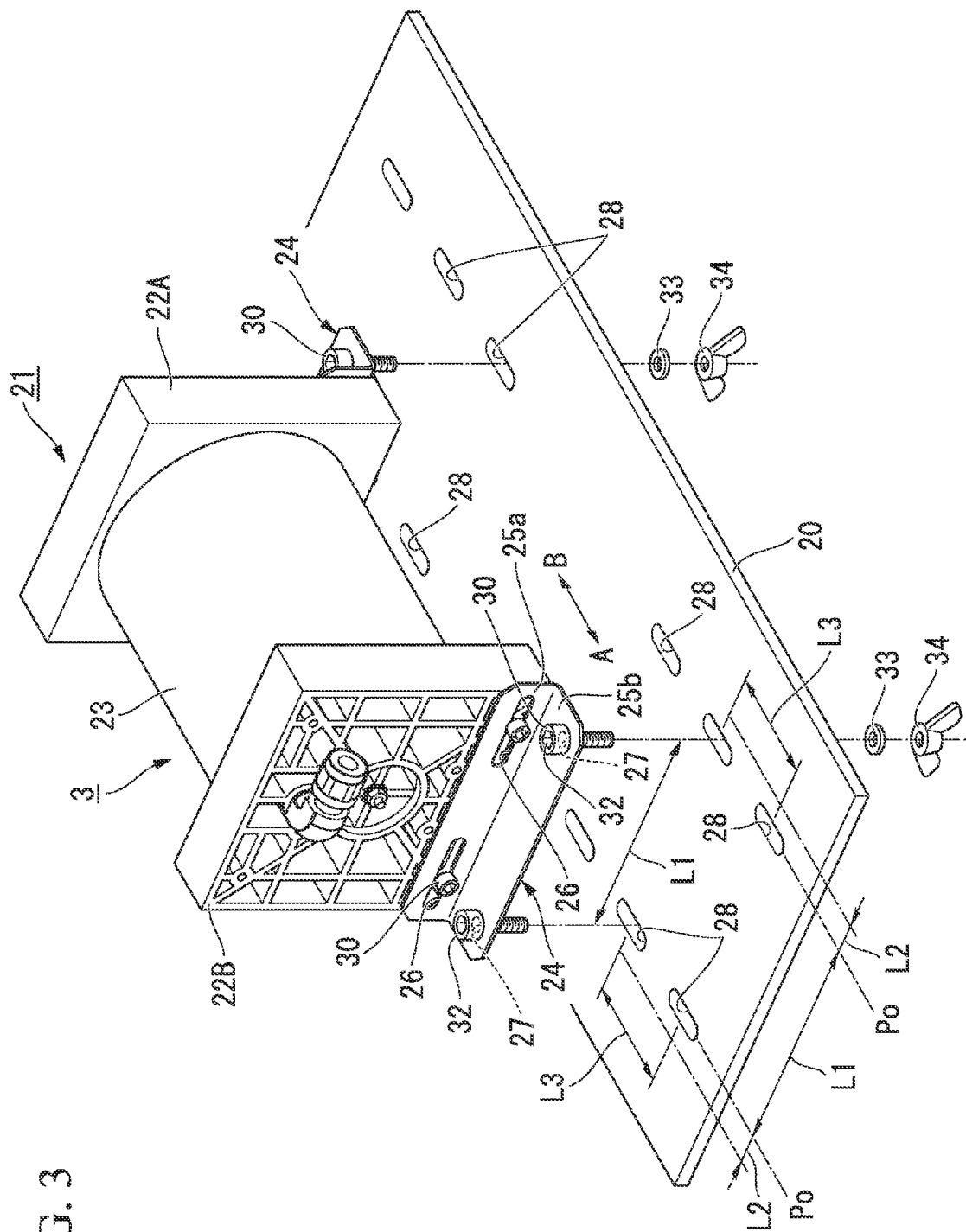


FIG. 4

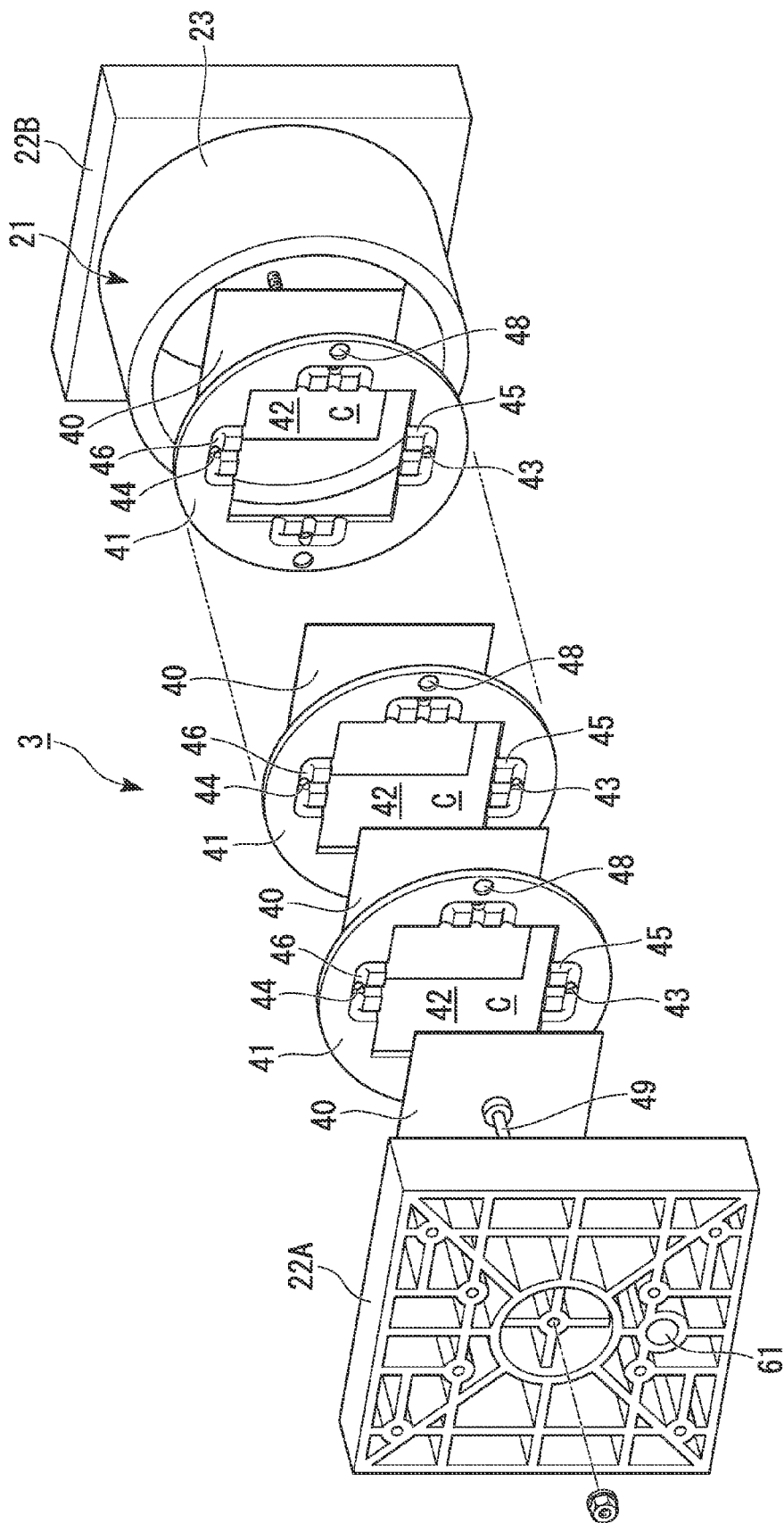


FIG. 5

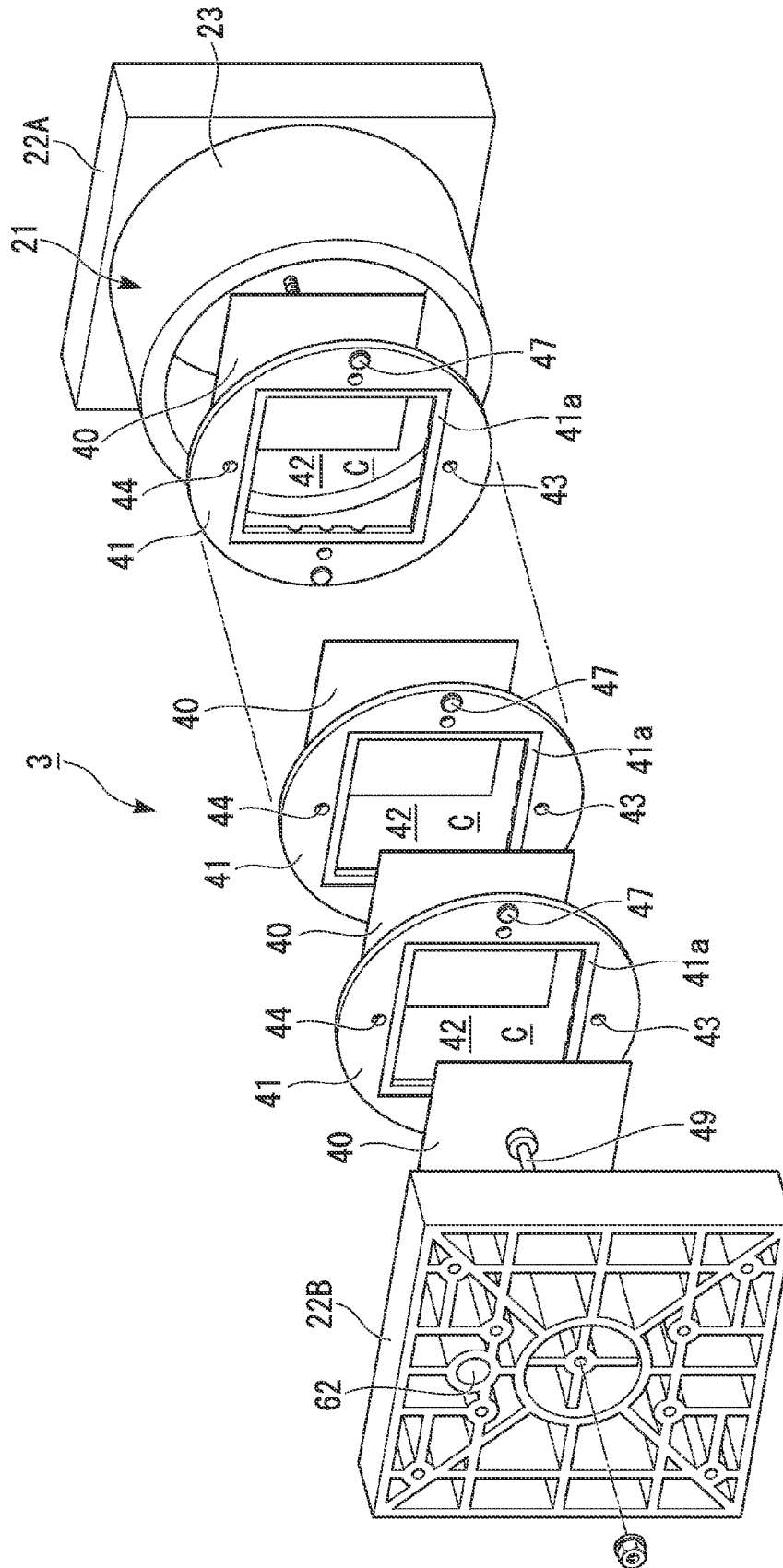


FIG. 6

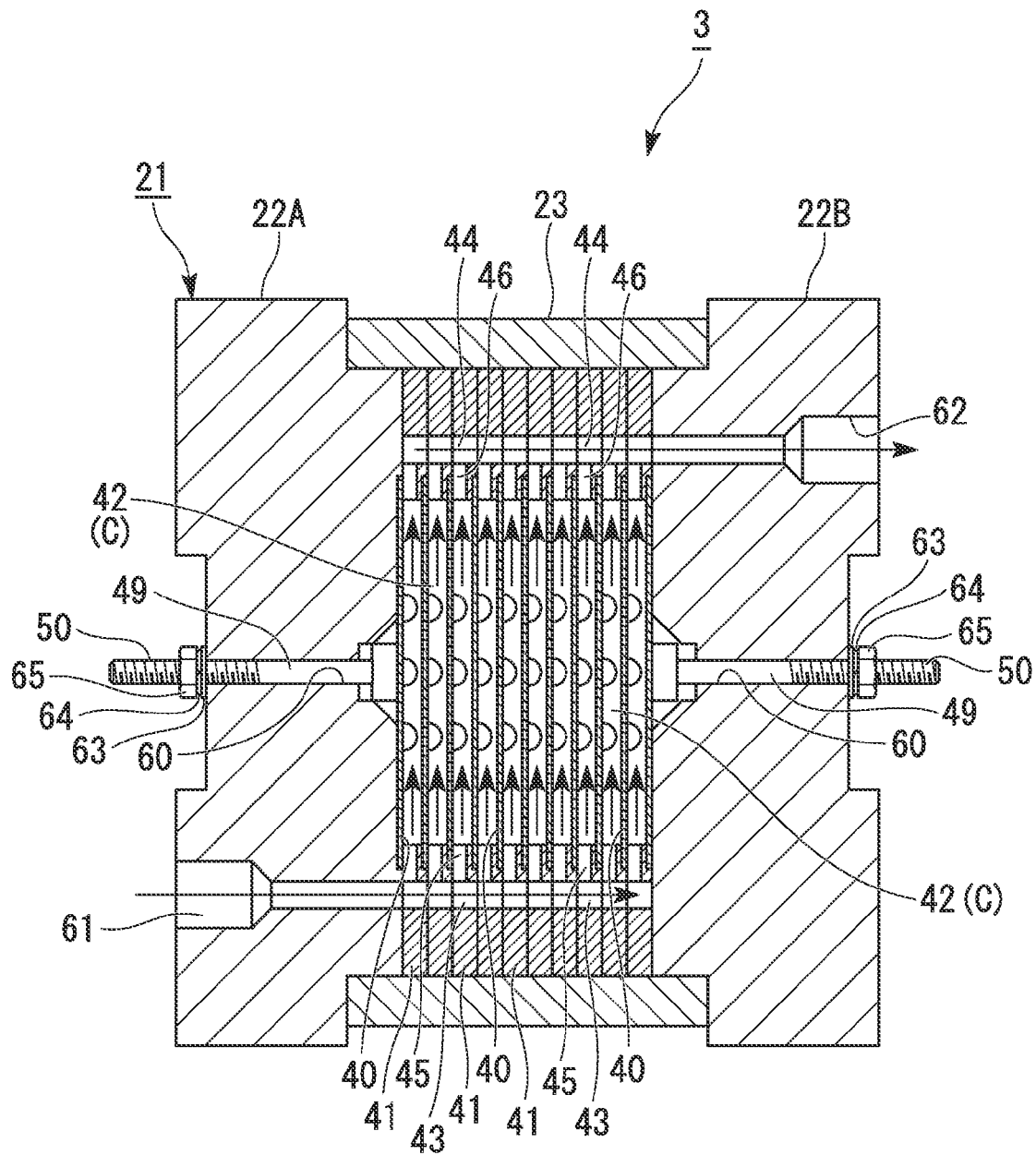


FIG. 7

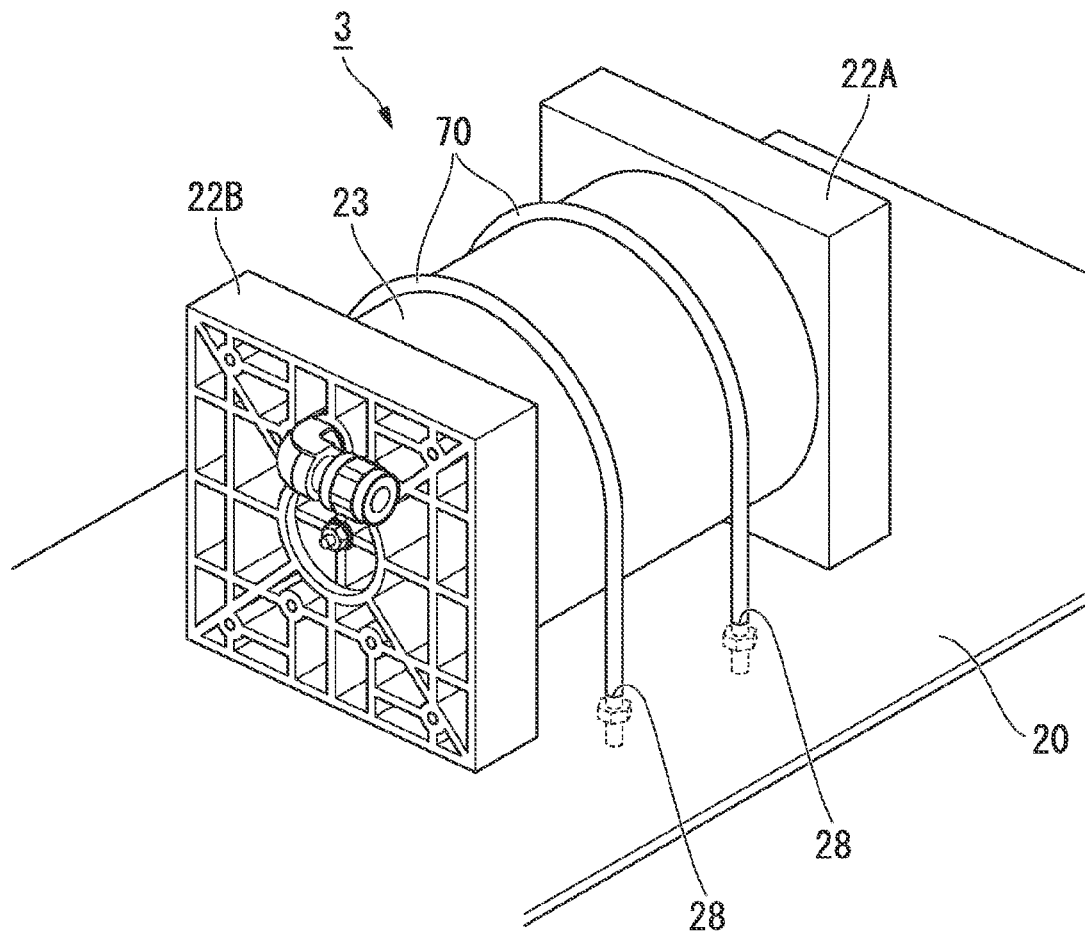
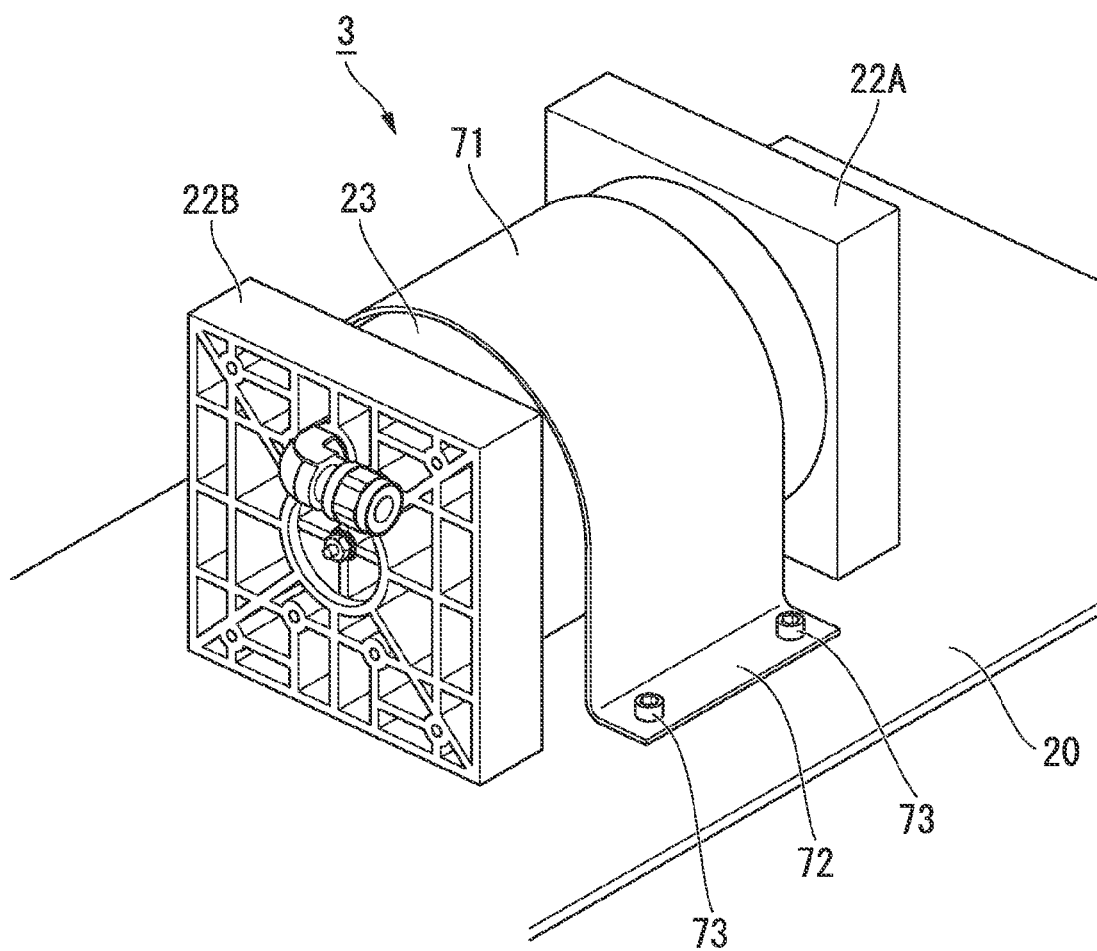


FIG. 8



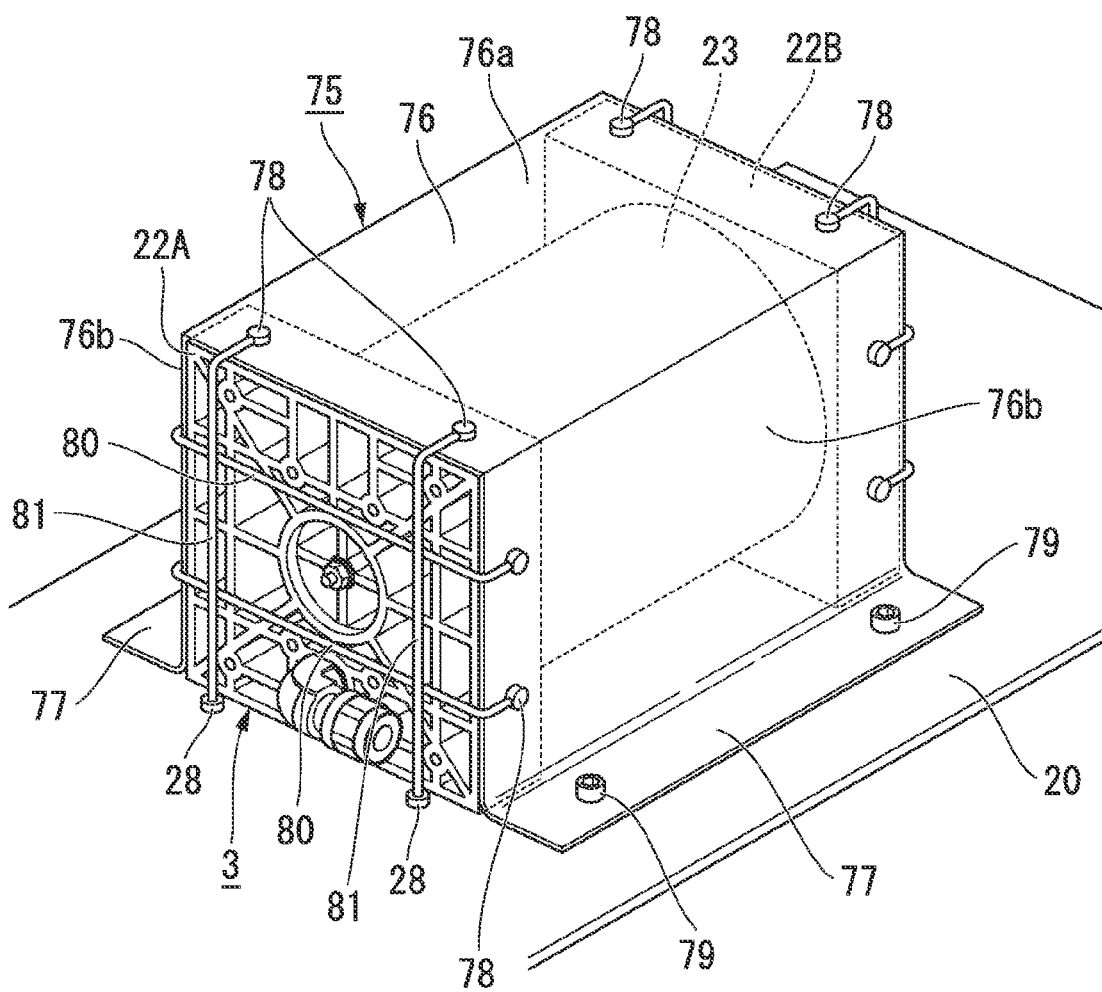


FIG. 10

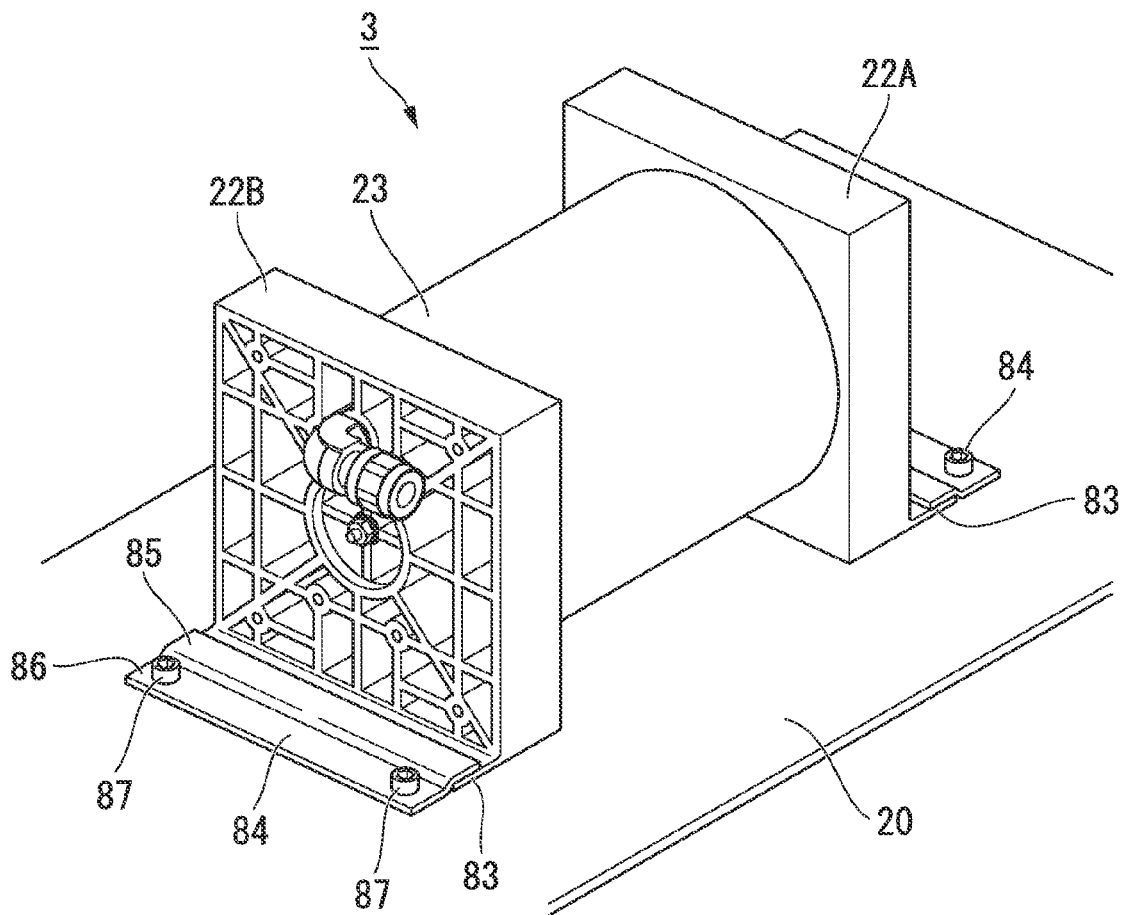


FIG. 11

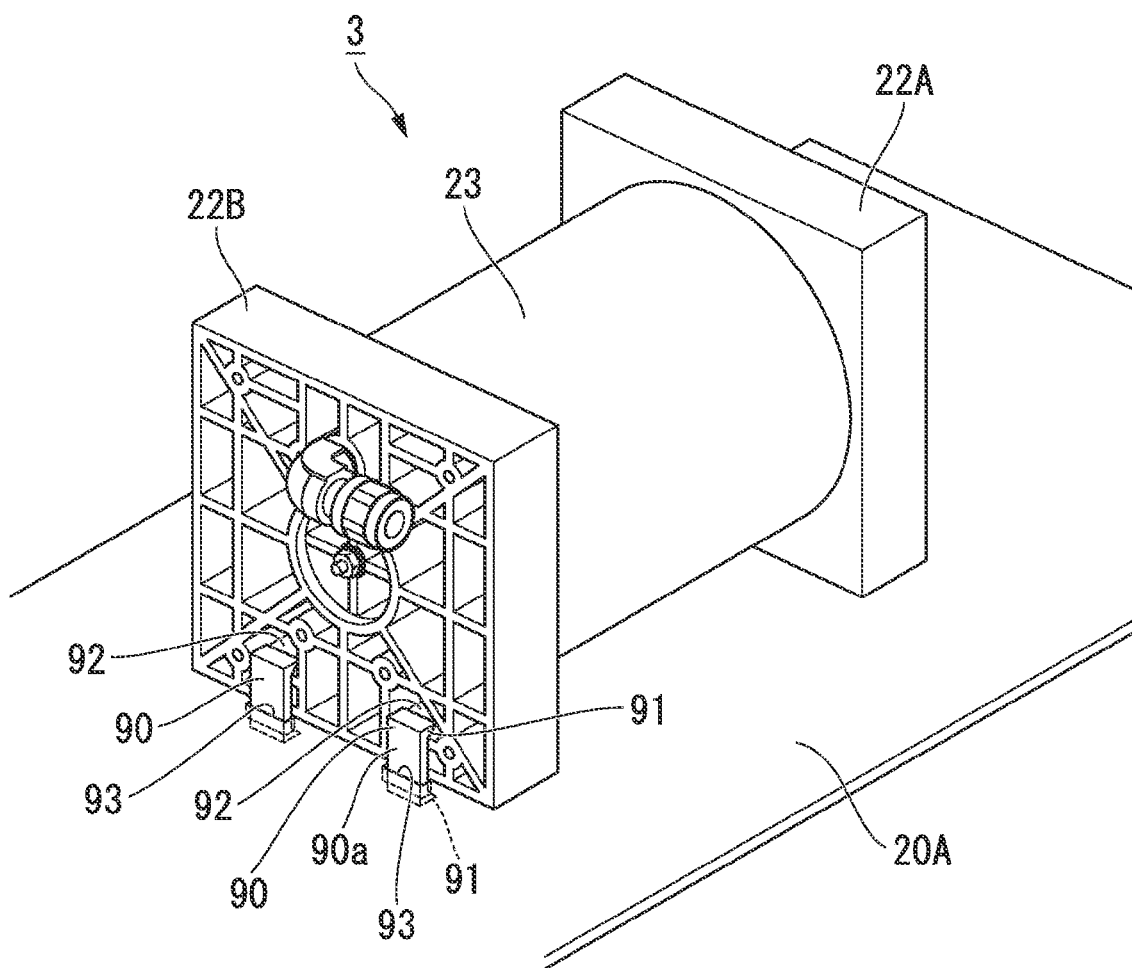


FIG. 12

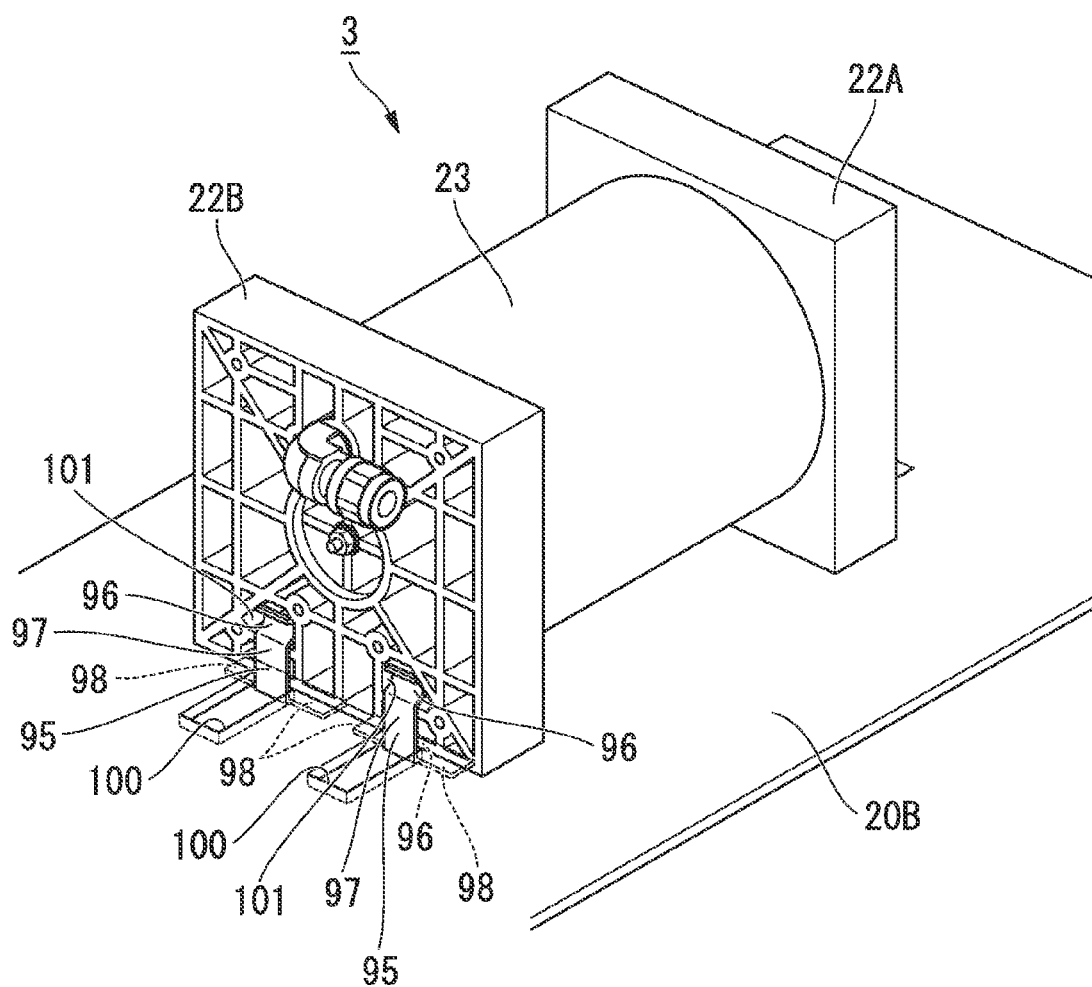


FIG. 13

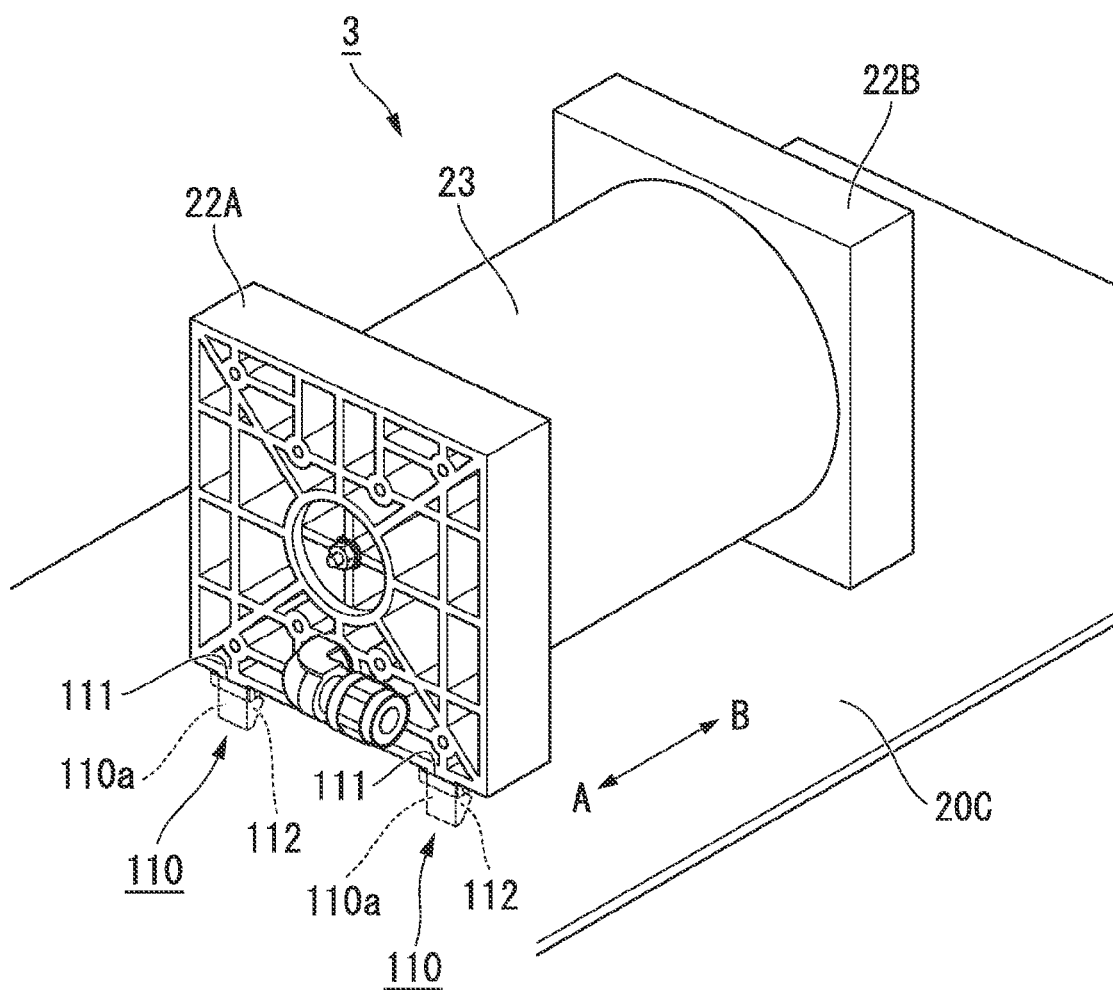


FIG. 14

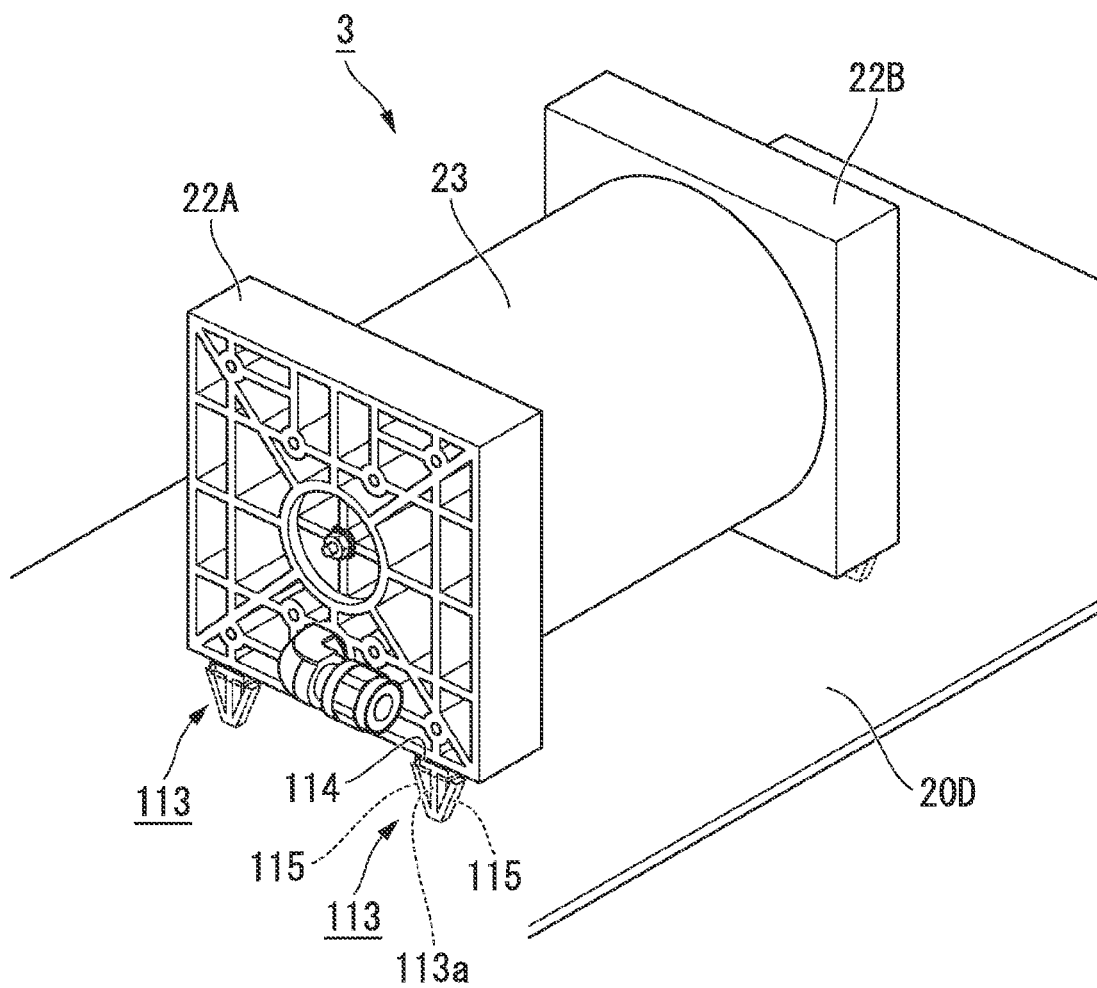


FIG. 15

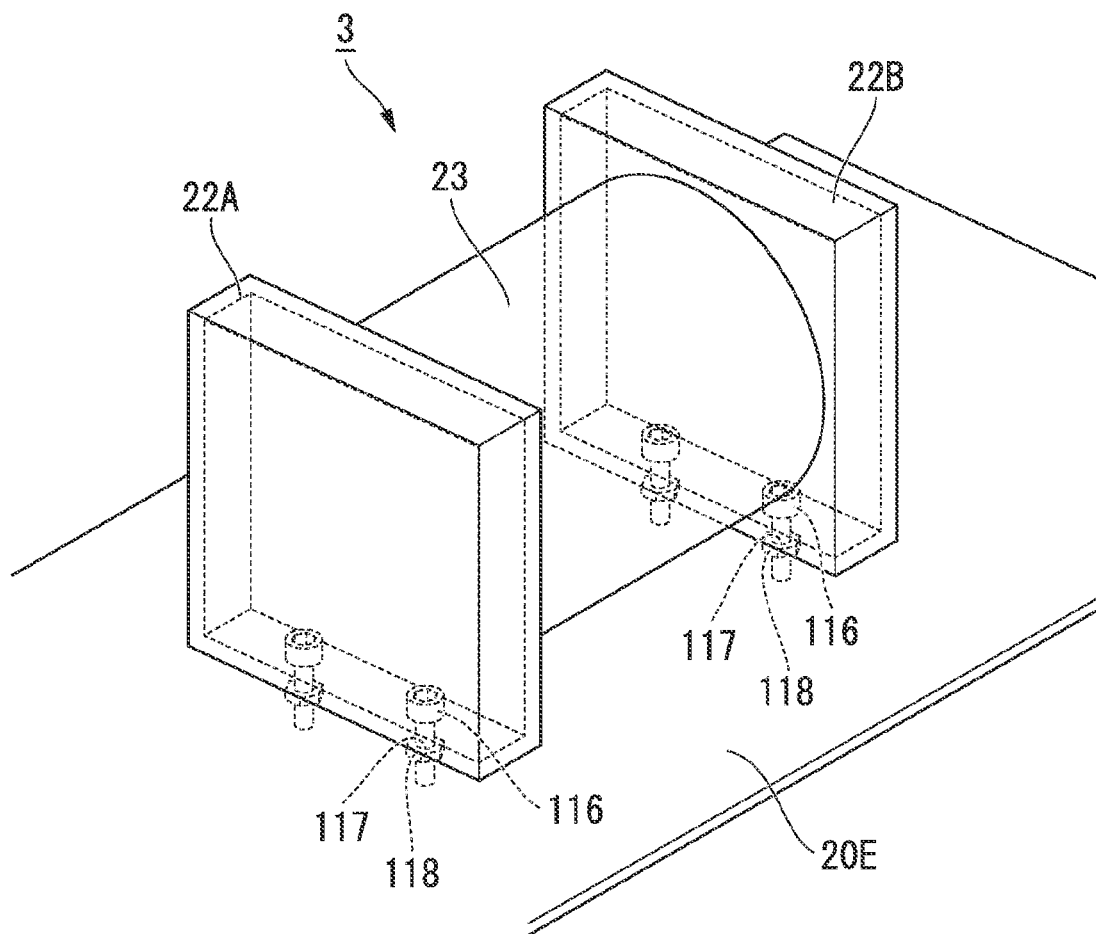
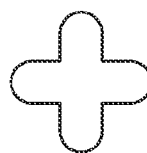


FIG. 16A



FIG. 16B



ELECTROLYSIS WATER-MAKING APPARATUS

TECHNICAL FIELD

The present invention relates to an electrolysis water-making apparatus for making electrolysis water to be used as sterilized water, by means of electrolysis in an electrolyte solution.

Priority is claimed on Japanese Patent Application No. 2009-296082, filed Dec. 25, 2009, the contents of which are incorporated herein by reference.

BACKGROUND ART

In recent years, electrolysis sterilized water is widely used for various sterilizing purposes in the area of food manufacturing. Electrolysis sterilized water in this case is produced by means of electrolysis performed on various types of solutions with use of an electrolysis water-making apparatus. There have been provided conventional electrolysis water-making apparatuses to be used in this type of purpose as disclosed in the following Patent Documents 1 to 3.

Electrolysis water-making devices disclosed in Patent Documents 1 to 3 are provided with: an electrolytic cell in which electrolysis is performed in an electrolyte solution; an installation base of the electrolytic cell and so forth; a water supply system for making an electrolyte solution; a tank for accommodating hydrochloric acid or the like; a mixer; a pump for pressure-pumping treatment water, hydrochloric acid, and so forth; a pipe group which connects these components of the apparatus; and an electrolysis power supply for supplying electric power to the electrolytic cell.

CITATION LIST

Patent Documents

[Patent Document 1] Japanese Unexamined Patent Application, First Publication No. 2006-167699

[Patent Document 2] Japanese Unexamined Patent Application, First Publication No. H11-169856

[Patent Document 3] Japanese Unexamined Patent Application, First Publication No. 2001-62455

DISCLOSURE OF INVENTION

Problems to be Solved by the Invention

Each electrolysis water-making apparatus differs in its manufacturing capacity of electrolyzed water, that is, the amount of electrolysis water the apparatus can make per hour, depending on the requirement of a customer. Therefore, usually in manufacturing this apparatus, an order is received from a customer, the capacity of each element of device is determined based on the order specification, and then, a dedicated component is manufactured and assembled for each constituent of the apparatus.

This also applies to the electrolysis water-making apparatuses disclosed in Patent Documents 1 to 3, and each apparatus is manufactured as a dedicated apparatus to meet the manufacturing capacity of electrolyzed water required by a customer.

Therefore, there is a problem in that the conventional electrolysis water-making apparatus disclosed in Patent Documents 1 to 3 each needs to be manufactured with apparatus components such as electrolytic cell, electrolytic cell instal-

lation base, and pipe group made for dedicated specification according to the required manufacturing capacity of electrolyzed water. As a result, manufacturing requires a large amount of work and time, and consequently, the entire manufacturing cost becomes high.

Means to Solve the Problems

In order to solve the above problem, the present invention provides the following means.

Specifically, a first aspect of the present invention is an electrolysis water-making apparatus where an electrolytic cell in which a unit cell is provided in a casing, is fixed to an installation base by a fixture attached to the electrolytic cell, and, through a pipe group, electrolyte solution is supplied into the electrolytic cell, and electrolyzed products produced in the electrolytic cell are delivered. The electrolysis water-making apparatus is characterized in that: in the installation base, there are formed one or two or more through holes, depending on the size of the electrolytic cell, through which through hole the end part of the fixture can be inserted; an end part of the fixture is inserted through a through hole, which is selected from the one or two or more through holes depending on the size of the electrolytic cell; and an end part of the fixture which projects from the installation base is locked on the installation base.

Here, there is no particular limitation on the shape of the one or two or more through holes in the installation base surface, through which the end part of the fixture can be inserted, provided that the electrolytic cell can be fixed on the installation base according to the arbitrary size of the electrolytic cell. The shape of the through holes in the installation base surface may be a long hole shape, and further, long holes may be combined in different directions. For example, they may be provided in a cross shape. Furthermore, in those cases where the shape of the through holes in the installation base surface is not a long hole shape, that is, where they are of a circular shape, it is preferable that two or more through holes are provided in a row so that the electrolytic cell can be fixed on the installation base.

The major axis of the long hole may be set while taking into consideration the element size and shape of the electrolytic cell to be used for the present invention, the size of the fixture to be attached to the electrolytic cell, and the thickness and shape of the spacer. However, the preferred major axis is for example 6.5 mm to 30.5 mm, and more preferably 12.5 mm to 18.5 mm, and at this time, the preferred minor axis is for example 3.5 mm to 12.5, and more preferably 4.5 mm to 10.5 mm. If the through hole in the installation base is of a circular shape, the diameter thereof is preferably 3.5 mm to 12.5, and more preferably 4.5 mm to 10.5 mm.

In those cases where the through holes are provided in a row, the preferred distance between the periphery parts of adjacent through holes is for example 65 mm to 30.5 mm, and more preferably 12.5 mm to 18.5 mm. The number of through holes to be provided in a row may be set while taking into consideration the element size and shape of the electrolytic cell to be used for the present invention, and the size and shape of the fixture to be attached to the electrolytic cell.

A second aspect of the present invention is characterized in that the electrolytic cell is provided with: a casing provided with a cylindrical casing pipe and side plates which block both ends of the casing pipe; a plurality of spacers which are provided in a row along an axial direction in the casing pipe, and which respectively have a hollow structure passing there-through in the axial direction; and a plurality of electrode plates which are arranged between each of the plurality of

spacers and on an outer side of the spacers positioned at both ends, and which cover the hollow structure to thereby provide the interior thereof as a unit cell.

A third aspect of the present invention is characterized in that at least a part of piping of the pipe group comprises a flexible pipe.

A fourth aspect of the present invention is characterized in that a shape of the hole is a cross shape.

Effect of the Invention

According to the electrolysis water-making apparatus of the present invention, the following effect can be achieved by the means described above.

Specifically, according to the electrolysis water-making apparatus of the first aspect of the present invention, as a configuration for fixing the electrolytic cell on the installation base, the end part of the fixture attached to the electrolytic cell, according to the size of the electrolytic cell, is inserted through the through hole selected from one or two or more through holes formed in the installation base and is locked thereon. Therefore there can be achieved an effect such that even if the size of the electrolytic cell differs depending on the volume of the electrolytic cell, each electrolytic cell can be fixed on the common installation base with respect to the electrolytic cell of different size, and also if the required manufacturing capacity of electrolyzed water differs, each electrolytic cell can be fixed on the common installation base with respect to the electrolytic cell of different size, the electrolysis water-making apparatus can be manufactured easily in a short period of time, and it can be provided at low cost.

According to the electrolysis water-making apparatus of the second aspect of the present invention, as a configuration of the electrolytic cell, there is provided a configuration such that inside the casing provided with a cylindrical casing pipe and side plates, there are arranged, along the axial direction of the casing pipe, a plurality of spacers and electrodes each having the same element configuration. Therefore there can be achieved an effect such that by increasing or decreasing the number of the spacers and electrodes, the manufacturing capacity of electrolyzed water of the electrolytic cell can be arbitrarily changed, the electrolytic cells of different production capacities can be manufactured using a plurality of spacers and electrodes each having the same element configuration, and the apparatus can be manufactured easily in a short period of time and can be provided at low cost.

According to the electrolysis water-making apparatus of the third aspect of the present invention, at least a part of the pipe group, which connect the components of the apparatus, comprises a flexible pipe. Therefore there can be achieved an effect such that even if the connecting location between the respective components differs depending on the manufacturing capacity of electrolyzed water of the apparatus, connection of the piping is possible, the apparatus can be easily manufactured in a short period of time without the need for changing the specification of the pipe group according to the manufacturing capacity, and the apparatus can be provided at low cost.

According to the electrolysis water-making apparatus of the fourth aspect of the present invention, the through hole in the installation base, through which the fixture of the electrolytic cell is inserted, is formed in a cross shape. Therefore there can be achieved an effect such that even if the size of the electrolytic cell differs not only in one direction but also in a direction orthogonal thereto, fixation of the electrolytic cell is possible.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram schematically showing a configuration of an electrolysis water-making apparatus of an embodiment of the present invention.

FIG. 2 is a schematic configuration diagram of the electrolysis water-making apparatus of the embodiment of the present invention.

FIG. 3 is an exploded perspective view showing an installation structure of an electrolytic cell shown in FIG. 2.

FIG. 4 is an exploded perspective view of the electrolytic cell shown in FIG. 2.

FIG. 5 is an exploded perspective view of the electrolytic cell shown in FIG. 2.

FIG. 6 is a longitudinal sectional view of the electrolytic cell shown in FIG. 2.

FIG. 7 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a first modified example.

FIG. 8 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a second modified example.

FIG. 9 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a third modified example.

FIG. 10 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a fourth modified example.

FIG. 11 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a fifth modified example.

FIG. 12 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a sixth modified example.

FIG. 13 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a seventh modified example.

FIG. 14 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing an eighth modified example.

FIG. 15 is a perspective view showing an installation structure of the electrolytic cell shown in FIG. 2, and is a diagram showing a ninth modified example.

FIG. 16A is a diagram showing a first modified example of a through hole to be formed in the installation base shown in FIG. 3.

FIG. 16B is a diagram showing a second modified example of a through hole to be formed in the installation base shown in FIG. 3.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

Hereunder, embodiments of an electrolysis water-making apparatus according to the present invention are described, with reference to the drawings. The present invention is not limited by these embodiments.

FIG. 1 is a schematic diagram of an electrolysis water-making apparatus A according to the present invention. In this diagram, reference symbol 1 denotes a water supply line for supplying treatment water from a raw water source (not shown in the figure), reference symbol 2 denotes a hydrochloric acid tank, and reference symbol 3 denotes an electrolytic cell.

Treatment water of the water supply line 1 is supplied by a dilution water pump 4, from pipes 5 and 6, through a pipe 7, to a pipe 8.

5

Hydrochloric acid within the hydrochloric acid tank **2** is supplied by a hydrochloric acid pump **9** from a pipe **10** to the pipe **8**.

Hydrochloric acid within the pipe **8** is diluted with the treatment water, and supplied into the electrolytic cell **3** as an electrolyte solution.

Electric power is supplied from an electrolysis power supply **11** to the electrolytic cell **3**, so that the electrolyte solution is electrolyzed in the electrolytic cell **3**, turning into electrolyzed products (electrolyzed solution and/or electrolyzed gas; examples thereof include hypochlorous acid and/or hydrogen gas) to be supplied through a pipe **12** to a mixer **13**. Treatment water is introduced to the mixer **13** from the pipe **5**, and in this mixer **13**, the treatment water and electrolyzed products are mixed and then supplied through a pipe **14** to a mixer **15**. In the case of FIG. **1**, the electrolyzed products are hydrogen gas and chlorine gas. The hydrogen gas and chlorine gas produced in the electrolytic cell **3** travel through the pipe **12**, and are mixed with water in the mixer **13**. As a result, the chlorine is partly dissolved in the water, and thereby becomes chlorine water (strong acidity). In the pipe **14**, the hydrogen gas, the remaining chlorine gas which did not dissolve, and the chlorine water are diluted in the mixer **15**, and hydrogen gas, which is unlikely to dissolve into hypochlorous acid water (slight acidity) and water, travels through a pipe **17**.

As electric power to be supplied from the electrolysis power supply, usually direct current power is used, and the amount of electric power fluctuates depending usually on the size of the electrode plates, the flow rate, and the available chlorine concentration. However, the preferred electric power is 24 VA to 1,872 VA, and more preferably 72 VA to 1,200 VA.

Treatment water is introduced into the mixer **15** from the water supply line **1**. In this mixer **15**, the concentration of electrolyzed products is adjusted, and the water is then delivered as electrolysis water which can be used as sterilized water, through the pipe **17**.

In the above configuration, the electrolytic cell **3**, the pumps **4** and **9**, the mixer **13**, and the respective pipes which connect these components are all housed within a chassis **16**.

FIG. **2** is a diagram showing a schematic configuration of the electrolysis water-making apparatus A. The same reference symbols in this diagram as those in FIG. **1** denote the same components as those in FIG. **1**.

The electrolysis water-making apparatus A is one where, even in a case where the manufacturing capacity of electrolyzed water differs in various types according to the specification required by a customer, common components and various types of components of different production capacities are prepared, to thereby facilitate apparatus production, and reduce production time of the apparatus and cost of the apparatus.

In order to achieve this object, in the electrolysis water-making apparatus A, for the electrolytic cell **3**, a plurality of electrolytic cells **3a**, **3b**, and **3c** each having a different manufacturing capacity of electrolyzed water are prepared. The electrolytic cells **3a**, **3b**, and **3c** differ from each other in the size thereof according to their manufacturing capacity. However, by providing a common installation base **20** with respect to the electrolytic cells each having a different manufacturing capacity, that is, each having a different size, each electrolytic cell **3** can be fixed on the installation base **20** by means of the same installation structure (to be described in detail later).

Moreover, also for the electrolysis power supply **11**, as with the electrolytic cells **3**, there are prepared a plurality of electrolysis power supplies **11a**, **11b**, and **11c** each having a different electric capacity. Any of these electrolysis power supplies **11a**, **11b**, and **11c** each having a different electric

6

capacity, that is, each having a different size, can be fixed on the installation base **20** by means of the same installation structure.

Furthermore, also for the water supply line **1**, there are prepared a plurality of water supply lines **1a**, **1b**, and **1c** each having a different water consumption, that is, each having a different size. Also for the mixer **15**, there are prepared a plurality of mixers **15a**, **15b**, and **15c** each having a different mixed quantity, that is, each having a different size, in a state of being attached to the respective water supply lines **1a**, **1b**, and **1c**. The preferred water consumption of the water supply line **1** is for example 1,800 L/hr to 1,000,000 L/hr, and more preferably 2,400 L/hr to 20,000 L/hr. Moreover, the preferred mixed quantity of the mixer **15** is for example 240 L/hr to 2,400 L/hr, and more preferably 600 L/hr to 1,200 L/hr.

Furthermore, either one or both of the pipe **7** and pipe **8**, or either one or both of these and the pipe **12** are configured with a flexible pipe. Also the other pipes **5**, **6**, **10**, and **14** may respectively be configured with a flexible pipe, so that even if the connecting locations differ due to the different size of the electrolytic cell **3**, they can be connected while the direction of extension can be freely changed.

It is preferable that the confluence point of the pipes **7** and **8** is closer to the electrolytic cell, and it is more preferable that the pipes **7** and **8** are directly connected to the electrolytic cell **3** respectively. This type of configuration facilitates flow rate control of hydrochloric acid and water flowing respectively from the pipe **7** and the pipe **8**.

FIG. **3** is a diagram showing an installation structure of the electrolytic cell **3** (**3a**, **3b**, and **3c**).

The electrolytic cell **3** is one where a unit cell, in which electrolysis in an electrolyte solution is performed, is formed within a casing **21**. The casing **21** comprises side plates **22A** and **22B**, and a casing pipe **23**. These are formed from a polyvinyl chloride, a polycarbonate, or a plastic such as polyacrylate.

The side plates **22A** and **22B** are plates having a rectangular plate-shaped appearance with a predetermined thickness. The casing pipe **23** is a member formed in a cylindrical shape, and inside there is formed a unit cell. The side plates **22A** and **22B** are arranged so as to cover the opening part of both ends, and are fixed on the casing pipe **23**.

As described later in the details of this electrolytic cell **3**, by increasing or decreasing the number of electrodes to be arranged within the casing pipe **23**, it is possible to achieve various types of manufacturing capacities of electrolyzed water. Moreover it is configured so that the lengthwise dimension of the casing pipe **23** differs depending on the number of electrodes.

This electrolytic cell **3** is fixed on the installation base **20** via fittings **24** which are bent in an L shape.

Each fitting **24** is such that in one L-shaped fitting plate part **25a**, there are formed long holes **26** which extend in the lengthwise direction, and in the other fitting plate part **25b**, there are formed holes **27**.

The electrolysis power supply **11** shown in FIG. **2** is fixed on the installation base **20** also by the same structure as with the electrolytic cell **3**, however, only the installation structure of the electrolytic cell **3** is described here.

The installation base **20** is formed to allow the electrolytic cell **3** to be fixed thereon according to each dimension thereof, so that even if the lengthwise or widthwise dimension of the casing pipe **23** of the electrolytic cell **3** is different, it can still be commonly used for each electrolytic cell **3** having a different size. The shape of the installation base **20** may be appropriately decided according to the overall design of the electrolysis water-making apparatus.

The installation base **20** is a plate having a certain thickness dimension. Between the plate surfaces thereof, there are formed a plurality of through holes **28** or the like.

There is no particular limitation on the material of the installation base **20** as long as it has strength to stably support members to be installed on the installation base **20**, however, a material with superior water resistance and corrosion resistance is preferred.

Specific examples of the material of the installation base **20** include titanium (Ti), stainless steel (SUS), polyvinyl chloride (PVC), iron (SPCC), and aluminum (Al), and stainless steel or titanium is preferred. Moreover, in order to give water resistance or corrosion resistance to a steel plate or aluminum plate, it may be one which has undergone coating or coating treatment with coatings or another coating material by means of a commonly practiced method.

Although it may differ depending on its material, if the material of the installation base **20** is stainless steel for example, the preferred thickness is 1.2 mm to 5.0 mm, and more preferably 1.5 mm to 4.0 mm.

In this case, the through holes **28** are separated by a distance **L1** between the holes **27** of the fitting **24**, and provided in a plurality of lines along the A-B arrow direction orthogonal to the direction between the holes **27**. Furthermore, they are provided outside by dimension **L2** from line positions **P0** of the through holes **28**, in a plurality of lines along the A-B arrow direction.

The through holes **28** are long holes which are long in the A-B arrow direction when viewed in the plate surface direction of the installation base **20**, and all intervals between the respective through holes **28** in the A-B arrow direction are the same length **L3**.

In order to fix the electrolytic cell **3** on the installation base **20**, first the fittings **24** are fixed on the lower end part of the outer surface of the side plates **22A** and **22B** of the electrolytic cell **3**.

In this case, male screws **30** are inserted through the long holes **26** of the fitting plate part **25a** of the fitting **24**, and these male screws **30** are screwed into female screw holes (not shown in the figure) which are formed in the outer surface of the side plates **22A** and **22B**, thereby performing the fixation. When performing this fixation, the holes provided in the fitting **24**, through which the male screws **30** are inserted, are the long holes **26**. Therefore even if the positions of the male screws **30** to be screwed into the side plates **22A** and **22B** of the electrolytic cell **3** are different depending on the size of the electrolytic cell **3**, by appropriately adjusting the positions of the male screws **30** within the long holes **26**, a difference in the position within a certain range can be absorbed, and the fitting **24** can be fixed on the side plates **22A** and **22B** of various types of electrolytic cell **3**.

Next, the electrolytic cell **3** with the above fittings **24** fixed thereon is mounted on the installation base **20**, the holes **27** of the fittings **24** are matched with the through holes **28**, male screws **32**, which constitute the fixture, are inserted from above into the holes **27** and the through holes **28**, washers **33** are fitted on the end part of the male screws **32** which project from the back surface side of the installation base **20**, and further wing nuts **34** are screwed on and tightened, to thereby complete the fixation.

In this case, even if the lengthwise dimension of the electrolytic cell **3** differs in various ways, fixation of electrolytic cells **3** of various lengths can be performed since the through holes **28** of the installation base **20**, through which the male screws **32** are inserted, are long holes, and the through holes **28** are provided in a plurality of lines along the A-B arrow direction.

FIG. **4** to FIG. **6** are diagrams showing a configuration of the electrolytic cell **3**.

The electrolytic cell **3** shown in these diagrams is configured as a bipolar electrolytic cell, and is configured such that inside the casing **21** comprising the side plates **22A** and **22B** and the casing pipe **23**, there are provided a plurality of electrode plates **40** and a plurality of spacers **41** alternately arranged in line along the axial direction of the casing pipe **23**.

Each electrode plate **40** is a metallic plate body composed of a titanium alloy or the like, and is formed, for example, in a rectangular (square) shape as shown in the figure. The preferred length of one edge of the rectangular electrode plate is 40 mm to 250 mm, and more preferably 50 mm to 200 mm.

Each spacer **41** is a plate-shaped member formed with a synthetic resin such as polyvinyl chloride, polycarbonate, and it formed for example, in a circular shape so that it can be housed within the pipe type axial body **23**. The preferred thickness of the spacer is 1 mm to 10 mm, and more preferably 2 mm to 5 mm.

The respective spacers **41** are arranged so as to be positioned between the respective electrode plates **40**. In the center part of the circular plate body of each of these spacers **41**, there is formed a rectangular hollow structure **42** passing through in the vertical direction to the plate surfaces (perpendicular). Around the hollow structure **42**, there is formed a concavity **41a**, and the electrode plate **40** is fitted in the concavity.

Moreover, the spacer **41** has a hole **43** formed in the lower part thereof and a hole **44** formed in the upper part thereof, and these holes **43** and **44** communicate with the hollow structure **42** through grooves **45** and **46**. The preferred diameter of the holes of the spacer is 2 mm to 15 mm, and more preferably 3 mm to 12 mm.

The diameter of the upper hole of the spacer may be the same as or may differ from that of the lower hole.

Moreover, the spacer **41** is such that on one of the surfaces thereof, there is formed a convex **47**, and on the other surface thereof, there is formed a concavity **48**. By fitting the convex **47** with the concavity **48**, the respective spacers **41** are connected with each other in a predetermined orientation.

Among the electrode plates **40**, in the center part of the electrode plates **40** positioned on both ends, there is fixed a metallic electrode bar **49**. The end part of the electrode bar **49** is provided as a male screw part **50** as shown in FIG. **6**.

On the other hand, in the side plates **22A** and **22B** respectively, in the center part thereof, there is formed an electrode through hole **60** which passes therethrough in the thickness direction. In the lower part of the side plate **22A**, there is formed an electrolyte solution inlet **61** passing therethrough in the thickness direction, and in the upper part of the side plate **22B**, there is formed an electrolyzed product outlet **62** passing therethrough in the thickness direction.

The electrolytic cell **3** comprising the above components is assembled such that the side plates **22A** and **22B** are arranged so as to oppose each other while having the casing pipe **23** therebetween, the electrode plates **40** and the spacers **41** are alternately arranged inside the casing pipe **23**, the electrode bar **49** fixed on the electrode plate **40** closest to the side plate **22A** is inserted through the electrode through hole **60** of the side plate **22A**, the electrode bar **49** fixed on the electrode plate **40** closest to the side plate **22B** is inserted through the electrode through hole **60** of the side plate **22B**, a nut **65** is screwed and tightened on the male screw part **50** of each electrode bar **49** while having a washer **63** and a spring washer **64** intervening thereon, and furthermore, the side plate **22A**, the casing pipe **23**, and the side plate **22B** are closely joined with each other.

In this case, each electrode plate **40** is fitted within the concavity **41a** of the adjacent spacer **41**, and the hollow structure **42** formed by the spacers **41**, on both sides thereof in the direction passing therethrough, is covered by the electrode plates **40** thereby forming an independent space. This space forms a unit cell C, in which electrolysis is performed in an electrolyte solution. The preferred volume of each unit cell C is 1.9 ml to 600 ml, and more preferably 3.9 ml to 190 ml.

Moreover, the holes **43** of each spacer **41** communicate with each other while communicating with the inlet **61** of the side plate **22A**, and the holes **44** of each spacer **41** communicate with each other while communicating with the outlet **62** of the side plate **22B**.

In order to produce electrolyzed products in the above electrolytic cell **3**, an electrolyte solution is supplied into the electrolyte solution inlet **61**, and this electrolyte solution is delivered to each unit cell C through the holes **43** and the grooves **45** or the like. The electrolyte solution in this case is produced such that hydrochloric acid supplied from the hydrochloric acid tank **2** shown in FIG. 1 to the pipe **8** by the hydrochloric acid pump **9**, is diluted with treatment water supplied from the pipes **5** and **6** by the dilution pump **4**. When electric power is supplied to the electrode bars **49** each serving as each positive and negative pole in this state, the electrolyte solution is electrolyzed within the unit cell C, and there is thereby produced an electrolyzed product in a state of being a mixture of a gas and liquid or primarily in a state of gas in this unit cell C. The electrolyzed product travels from the unit cell C through the grooves **46** and the holes **44** of the respective spacers **41**, and is extracted from the outlet **62**.

The electrolyzed product extracted from the outlet **62** is mixed with treatment water in the mixers **13** and **15** shown in FIG. 1, and it is then delivered as electrolysis sterilized water to various places.

In the above electrolytic cell **3**, the electrode plate **40** and the spacer **41** are common components each having the same common specification, and by increasing or decreasing the number of these electrode plates **40** and spacers **41**, the manufacturing capacity of electrolyzed water can be changed. That is to say, in the case of manufacturing the electrolytic cell **3** with various types of manufacturing capacities of electrolyzed water, the number of the electrode plates **40** and the spacers **41** are set to appropriate numbers for obtaining a required level of electrolyzed products, and the length of the casing pipe **23** may be set according to these numbers. The number of the spacers **41** is usually 1 to 30, and is preferably 6 to 24. The number of the electrode plates **40** may be decided according to the number of the spacers **41**.

As described above, the electrolysis water-making apparatus A is to schedule manufacturing at different manufacturing capacities of electrolyzed water, and to prepare for manufacture a plurality of components with different production capacities.

That is to say, as components with different production capacities, water supply lines **1a**, **1b**, and **1c**, electrolytic cells **3a**, **3b**, and **3c**, electrolysis power supplies **11a**, **11b**, and **11c**, and mixers **15a**, **15b**, and **15c** or the like may be arbitrarily prepared.

Moreover, there is provided a configuration of using a common installation base **20** with respect to various types of electrolytic cells, so that various types of electrolytic cells **3** can be installed even if the lengthwise dimensions of the electrolytic cells **3** are different.

That is to say, on the installation base **20** there are provided a plurality of through holes **28** each formed as a long hole at

constant intervals in a plurality of lines, so that installation of various types of electrolytic cells **3** is possible.

Furthermore, on this installation base **20**, there may be installed various types of electrolysis power supplies **11** with different sizes, as with the electrolytic cells **3**.

Moreover, in the present embodiment, the pipes **6**, **7**, **8**, **10**, and **12** are configured with flexible pipes. Therefore connection can still be established even if the size of the electrolytic cells **3** or the like is different. In the present embodiment, the pipes **5** and **14** are fixed pipes, however, these may also be configured with flexible pipes.

Furthermore, as for the electrolytic cell **3**, by increasing or decreasing the number of the electrode plates **40** and the spacers **41**, and by appropriately setting the length of the casing pipe **23**, various types of electrolytic cells with different manufacturing capacities of electrolyzed water can be manufactured.

Therefore, according to this electrolysis water-making apparatus A, there can be achieved an effect such that various types of apparatuses with different manufacturing capacities of electrolyzed water can be easily manufactured in a short period of time, and the apparatus can be provided at low cost.

FIG. 7 to FIG. 15 respectively show modified examples of the installation structure of the electrolytic cell **3**. Installation structures shown in these FIG. 7 to FIG. 10 respectively take the installation base **20** shown in FIG. 3 as an installation target of the electrolytic cell **3**.

The installation structure shown in FIG. 7 is such that the electrolytic cell **3** is fixed using U-shaped clips **70**, which constitute the fixture.

The clip **70** is formed in a U shape, and both of the end parts thereof are provided as being a male screw part (not shown in the figure).

In this installation structure, each curve part of these two clips **70** is locked on the casing pipe **23** of the electrolytic cell **3**, both of the end parts each provided as being a male screw part are inserted through the through holes **28** of the installation base **20**, a washer is fitted on each male screw part which projects to the back surface side of the installation base **20**, and a nut is fitted and tightened thereon, to thereby fix the electrolytic cell **3**.

The installation structure shown in FIG. 8 is to fix the electrolytic cell **3** using a fixed material **71** of a belt like structure.

The fixed material **71** is provided such that a belt like plate body is formed in a U shape, a fixed plate **72** projecting outward is formed on both ends thereof, and installation holes are formed in the fixed plate **72**.

In this installation structure, the curved part of the fixed material **71** is locked on the casing pipe **23** of the electrolytic cell **3**, and the fixed plate **72** is fixed on the installation base **20** using male screws **73** and nuts, which constitute the fixture.

The installation structure shown in FIG. 9 is to fix the electrolytic cell **3** using a fixed material **75**.

The fixed material **75** comprises a main body **76** which is bent in a U-shaped type so as to cover the side plates **22A** and **22B** of the electrolytic cell **3**, and a fixed plate **77** which projects outward from this main body **76**, and in the fixed plate **77**, there are formed installation holes. In this case, the main body **76** comprises a top plate **76a** and side plates **76b**, and pins **78** are fixed on the side end of each of these parts.

In this installation structure, after having mounted the electrolytic cell **3** on the installation base **20**, the fixed material **75** is placed over the entire electrolytic cell **3**, and the fixed plate **77** is fixed on the installation base **20** using male screws **79** and nuts which constitute the fixture. Furthermore, linear fixed materials **80** are arranged so as to bridge between the

11

pins **78** of the side plates **76b**, one end of a linear fixed material **81** is locked on the pin **78** on the top plate, and the other end is inserted through the through hole **28** to the back surface side of the installation base **20** and it is locked thereon.

The installation structure shown in FIG. **10** is such that a fixed plate **83** which projects outward, is provided on the side plates **22A** and **22B** of the electrolytic cell **3** first, and this fixed plate **83** is fixed on the installation base **20** using a fixed material **84**.

The fixed material **84** comprises a support plate **85** which presses and supports the fixed plate **83**, and a fixed plate **86** which continues to this support plate **85**, and installation holes are formed in the fixed plate **86**.

In this installation structure, having brought the support plate **85** of the fixed material **84** into contact with the upper surface of the fixed plate **83**, the fixed plate **86** is fixed on the installation base **20** using male screws **87** and nuts which constitute the fixture.

The installation structure shown in FIG. **11** is such that a fixture **90** with latching parts **91** provided on upper and lower parts of a plate-shaped main body **90a** is used, the latching part **91** on the upper part of this fixture **90** is latched on an opening part **92** formed in the side plates **22A** and **22B** of the electrolytic cell **3**, the main body **90a** of the fixture **90** is inserted through a through hole **93** provided in the installation base **20A**, and the lower latching part **91** is engaged with the back surface of the installation base **20A**.

In this structure, as with the through holes **28** shown in FIG. **3**, the through holes **93** are provided in a plurality of lines on the installation base **20A**, while the sectional shape of each through hole is formed in a shape which allows the fixture **90** to be inserted therethrough.

The installation structure shown in FIG. **12** is such that as with the above fixture **90** shown in FIG. **11**, a fixture **97** with latching parts **96** provided on upper and lower parts of a plate-shaped main body **95** is used, and the fixture **97** has catching plates **98**, which project sideward, formed on the lower latching part **96**.

Meanwhile, on an installation base **20B** on which the electrolytic cell **3** is to be fixed, there are formed through holes **100** each extending long in one direction.

In this installation structure, the fixture **97** is inserted through the through hole **100** from the lower side of the installation base **20B** to have the lower catching plates **98** engaged with the back surface side of the installation base **20B**, and the upper latching part **96** of the fixture **97** which has reached the front surface side of the installation base **20B** is engaged with an opening part **101** formed in the side plates **22A** and **22B**, to thereby perform fixation of the electrolytic cell **3**.

In this structure, by adjusting the position of the fixture **97** within the through hole **100**, it is possible to fix various types of the electrolytic cells **3** even if the length of the electrolytic cell **3** is different.

The installation structure shown in FIG. **13** is such that an elastically deformable fixture **110** is provided on the lower surface of the side plates **22A** and **22B** of the electrolytic cell **3**, and this fixture **110** is engaged within through holes **111** provided in a plurality of lines on an installation base **20C**.

The fixture **110** comprises a plate-shaped main body **110a** to be fixed on the side plate **22A** (**22B**), and a clamping projection **112** formed at the lower end of this main body **110a**.

In this structure, the main body **110a** of the fixture **110** is elastically deformed in the arrow A direction to be inserted into the through hole **111**, and then, the main body **110a** is elastically returned in the arrow B direction to thereby bring

12

the clamping projection **112** into contact with the lower surface of the installation base **20C**.

The installation structure shown in FIG. **14** is such that a fixture **113** is provided on the lower surface of the side plates **22A** and **22B** of the electrolytic cell **3**, and this fixture **113** is engaged within through holes **114** provided in a plurality of lines on an installation base **20D**.

In this structure, the fixture **113** has engaged projections **115** formed so as to gradually expand with upward approach to the lower end part of a plate-shaped main body **113a**. The engaged projections **115** are capable of elastic deformation with respect to the main body **113a**.

The fixture **113** is inserted into the through hole **114** while the engaged projections **115** are elastically deformed and the upper ends thereof are brought into close proximity to each other, and then the engaged projections **115** are elastically returned to be thereby engaged with the back surface of the installation base **20D**.

The installation structure shown in FIG. **15** is such that a male screw **116** is buried in the lower part of the side plates **22A** and **22B** of the electrolytic cell **3** so that the lower end part thereof projects downward, the lower end part of this male screw **116** is inserted into a through hole **117** provided in a plurality of lines of an installation base **20E**, and a nut **118** is fitted and tightened on the lower end part projecting from the back surface of the installation base **20E**.

In each embodiment above, various types of aspects of through holes to be formed in the installation base have been illustrated. However, in addition to the aspects illustrated in each embodiment above, there may be provided an aspect of providing through holes each in a perfectly circular shape when viewed in the plate-surface direction of the installation base, in a plurality of lines as shown in FIG. **16A**, or an aspect of providing it in a cross shape as shown in FIG. **16B**. Provided it commonly allows fixation for the aspect of various sizes of the electrolytic cells, then this is sufficient.

Moreover, in the above embodiments, there has been described a case where the length of the electrolytic cell **3** is different, that is, where the length differs depending on the number of electrode plates and spacers according to the manufacturing capacity of electrolyzed water. However, the manufacturing capacity of electrolyzed water of the electrolytic cell **3** may be changed by increasing or decreasing the area of electrode plate. If the area of electrode plates of the electrolytic cell **3** is increased or decreased, the diameter of the casing pipe **23** increases or decreases. Therefore, to match with this type of aspect of the electrolytic cell **3**, there may be used through holes **28** formed in the widthwise direction (C-D direction) of the electrolytic cell **3** among the through holes **28** shown in FIG. **3**.

Moreover, the installation bases **20**, and **20A** to **20E** are respectively arranged on the lower side of the electrolytic cell **3** to mount and fix the electrolytic cell **3** thereon in the above embodiments. However, there may be provided an aspect such that this type of installation base is rotated 90 degrees about the lengthwise direction so as to stand upright in the perpendicular direction, and the electrolytic cell **3** is fixed on this standing installation base. That is to say, the angle of the installation base may be arbitrary, in other words, the electrolytic cell **3** may be fixed on a side wall, or may even be fixed on a ceiling.

In the electrolysis water-making apparatus of the present invention, conventional techniques commonly known in the technical field of the present invention may be applied to; the water supply system for making electrolyte solutions, the tank for accommodating hydrochloric acid or the like, the mixers, the pumps for pressure-pumping treatment water,

13

hydrochloric acid, and so forth, the pipe group which connects these components of the apparatus, and the electrolysis power supplies for supplying electric power to the electrolytic cell.

INDUSTRIAL APPLICABILITY

According to the electrolysis water-making apparatus of the present invention, even in a case where the size thereof differs depending on the volume of the electrolytic cell, and also in case where the required manufacturing capacity of electrolyzed water differs, each electrolytic cell can be fixed on a common installation base with respect to electrolytic cells of different sizes. Therefore, the electrolysis water-making apparatus can be easily manufactured in a short period of time, and can be provided at low cost.

DESCRIPTION OF THE REFERENCE SIGNS

A: Electrolysis water-making apparatus

1: Water supply line

3, 3a, 3b, 3c: Electrolytic cell

4: Dilution pump

5, 6, 7, 8, 10, 12, 14: Pipe (flexible pipe)

9: Hydrochloric acid pump

20, 20A to 20E: Installation base

21: Casing

22A, 22B: Side plate

23: Casing pipe

26: Long hole

27: Hole

28, 93, 100, 111, 114, 117: Through hole

32, 70, 73, 79, 87, 90, 97, 110, 113: Fixture

41: Spacer

42: Hollow structure (Hollow)

The invention claimed is:

1. An electrolysis water-making system comprising:

a plurality of electrolytic cells different from each other in a size thereof according to their manufacturing capacity, and

an electrolysis water-making apparatus comprising:

one electrolytic cell in which a unit cell is provided in a casing, said one electrolytic cell being selected from the plurality of electrolytic cells different from each other in a size thereof according to their manufacturing capacity;

an installation base to which said one electrolytic cell is fixed by a fixture attached to said one electrolytic cell;

a pipe group through which electrolyte solution is supplied into the one electrolytic cell and electrolyzed products produced in the one electrolytic cell are delivered; and a chassis, wherein said one electrolytic cell, said installation base and a part of said pipe group are housed within said chassis;

wherein in said installation base, there are provided a plurality of through holes at constant intervals in a lengthwise direction of said one electrolytic cell in a plurality of lines, the plurality of lines of through holes being provided so that any of the plurality of electrolytic cells different from each other in a size thereof according to their manufacturing capacity can be installed on said

14

installation base, and at least two lines of through holes being selectable from the plurality of lines of through holes depending on the size of said one electrolytic cell selected from the plurality of electrolytic cells, through which through holes of said at least two lines end parts of said fixture can be inserted;

the end parts of said fixture are inserted through said through holes, which are selectable from the plurality of through holes of said at least two lines depending on the size of said one electrolytic cell; and

the end parts of said fixture which project from said installation base are locked on said installation base.

2. The electrolysis water-making system according to claim 1, wherein said one electrolytic cell is provided with:

said casing provided with a cylindrical casing pipe and side plates which block both ends of said casing pipe;

a plurality of spacers which are provided in a row along an axial direction in said casing pipe, and which respectively have a hollow structure passing therethrough in said axial direction; and

a plurality of electrode plates which are arranged between each of said plurality of spacers and on an outer side of the spacers positioned at both ends, and which cover said hollow structure to thereby provide the interior thereof as the unit cell.

3. The electrolysis water-making system according to claim 1, wherein at least a part of piping of said pipe group comprises a flexible pipe.

4. The electrolysis water-making system according to claim 1, wherein a shape of at least one through hole of the plurality of through holes is a cross shape.

5. The electrolysis water-making system according to claim 2, wherein at least a part of piping of said pipe group comprises a flexible pipe.

6. The electrolysis water-making system according to claim 2, wherein a shape of at least one through hole of the plurality of through holes is a cross shape.

7. The electrolysis water-making system according to claim 3, wherein a shape of at least one through hole of the plurality of through holes is a cross shape.

8. The electrolysis water-making system according to claim 5, wherein a shape of at least one through hole of the plurality of through holes is a cross shape.

9. The electrolysis water-making system according to claim 1, wherein a shape of at least one through hole of the plurality of through holes is a long hole in the lengthwise direction of said one electrolytic cell, a major axis of the long hole being 6.5 mm to 30.5 mm and a minor axis of the long hole being 3.5 mm to 12.5 mm.

10. The electrolysis water-making system according to claim 1, wherein said constant intervals in the lengthwise direction of said one electrolytic cell is a distance of 6.5 mm to 30.5 mm between periphery parts of adjacent through holes of the plurality of through holes in the lengthwise direction of said one electrolytic cell.

11. The electrolysis water-making system according to claim 10, wherein said constant intervals is a distance of 12.5 mm to 18.5 mm.

* * * * *